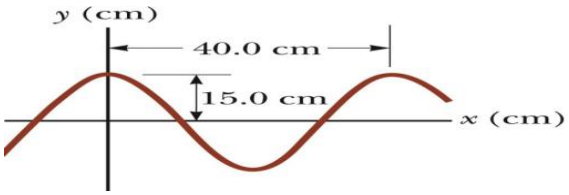
SECTION A: All questions are compulsory /55marks

1. a) what is a crest of a mechanical wave? **/0.5marks**

b) Estimate the length of distance between a node and a neighboring antinode in terms of a wavelength. **/0.5marks**

2. A sinusoidal wave traveling in the positive x direction has an amplitude of 15.0 cm, a wavelength of 40.0 cm, and a frequency of 8.00 Hz. The vertical position of an element of the medium at t=0 and x=0 is also 15.0 cm.



a) Find the wave number k, period T, angular frequency ω, and speed v of the wave. **/2marks**

b) Determine the phase constant and write a general expression for the wave function. **/2marks**

3. Sketch the circuit diagram for the following situation. Four light bulbs P, Q, R, S are connected in a circuit of unknown arrangement. when each bulb is removed one at a time and replaced, the following behavior is observed. **/4marks**

	P	Q	R	S
P removed	*	On	On	On
Q removed	On	*	On	off
R removed	Off	Off	*	Off
S removed	On	off	On	*

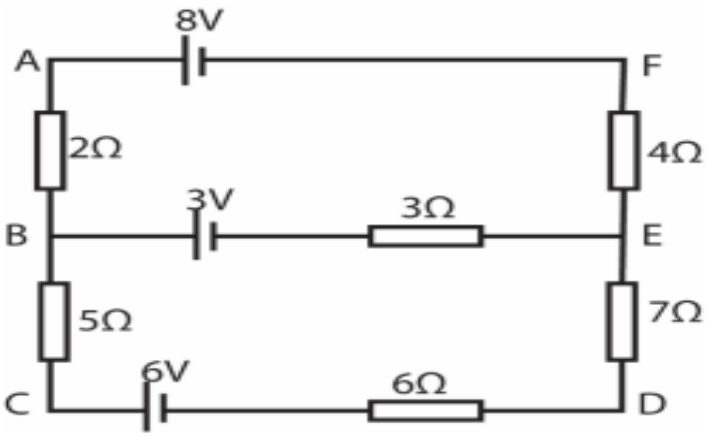
4. a.

i) State the factors which affect the resistance of a conductor. **/2marks**

ii) Outline the principle of a slide wire potentiometer. **/2marks**

b. Describe, with the aid of circuit diagram how a slide wire potentiometer can be used to measure e.m.f of a cell. /**4marks**

c) In the figure, find the current flowing through the 2Ω, 3Ω and 6Ω resistor. **/7marks**



5. explain the following terms: **/4marks**

a) Fossil fuel
b) Controlled fission
c) Crude oil
d) Nuclear energy

6. Defend how fossil fuels are origin of observable climate change /**5marks**

7. Give the comparative analysis between light microscopy and electron microscope. **/4marks**

8. A metal ball of radius 3 cm is heated to $5000^0\ C$. If its emissivity is 0.5, at what rate does it radiate the energy? **/2marks**

9. Make a plan about the failures of classical physics. **/3marks**

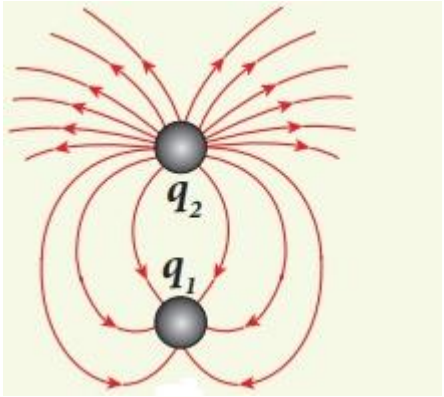
10. define the spring constant. **/1mark**

11. a 1.75 kg particle moves as function of time as follows $x = 4\cos\left(1.33t + \frac{\pi}{5}\right)$ where distance is measured in meters and time is seconds. Calculate the velocity of this particle for time $(t = 5s)$. **/3marks**

12. Define the resonant frequency (f_0) **/1mark**

13. Compare simple harmonic motion and damped oscillation **/3marks**

14. The following pictures depict electric field lines for various charges configurations.



a) In figure above, identify the signs of two charges. **/1mark**

b) In figure above find the ratio $|q_1/q_2|$. **/2marks**

15. Calculate the electric flux through the rectangle of sides 5 cm and 10 cm kept in the region of a uniform electric field 100 NC^{-1}. The angle θ is 60^o. Suppose θ becomes zero, what is the electric flux? **/2marks**

SECTION B: Attempt any 3 questions /45marks

16.

a) In a photoelectric effect experiment, which of the following factors will increase, decrease or will not affect the maximum kinetic energy of the photoelectrons? In each case justify your answer on the basis of Einstein's photoelectric equation : $\frac{1}{2}mv_{max}^2 = hf - \phi$

i) Use light of greater intensity. **/2marks**

ii) Use light of higher frequency. **/2marks**

iii) Use light of longer wavelength. **/2marks**

iv) Use a metal surface of longer work function. **/2marks**

b) The photoelectric work function of potassium is 2.3ev. The light having wavelength of 250nm falls on potassium.

i) Convert 2.3ev in joules. **/2marks**

ii) Find the frequency. **/2marks**

iii) Calculate the maximum kinetic energy of the photoelectrons. **/3marks**

17. A 50g mas vibrates in SHM at the end of a spring. The amplitude of the motion is 12cm, and the period is 1.7s. Find:

a) The frequency. **/3marks**

b) The spring constant. **/3marks**

c) The maximum speed of the mass. **/3marks**

d) The maximum acceleration of the mass. **/3marks**

e) The speed and acceleration when the displacement x is 6.0cm. **/3marks**

18. An object of mass m=0.2kg is hung from a spring whose spring constant is 80Nm^{-1}. The body is subject to a resistive force given by –bv, where v is its velocity and b=4$Nm^{-1}s$.

a) Set up a differential equation of motion free oscillations of the system, and find the period of such oscillations. **/4marks**

b) The object is subjected to a sinusoidal force given by$F(t) = Fo \sin(\omega t)$, where $Fo = 2\ N$ and $\omega = 30 rad/s$. In steady state, what is the amplitude of the forced oscillations? **/4marks**

c) Instead of a driving force, we now oscillate the end of the spring at the top and vertically with a harmonic displacement$x = xo \sin(\omega t)$. Set up the differential equation of motion for this driven oscillator. **/3marks**

d) What is the amplitude of the mass in steady state for$\omega = 300\ rad/s$, if $xo = 0.5cm$ in each case? **/4marks**

19. Gravitational potential:

a. The period of vibration P of a star under its own gravitational attraction is given by

$p = \frac{2\pi}{\sqrt{G\sigma}}$ = where σ is the mean density of a star and G is the gravitational constant . Show whether or not this relation is dimensionally correct. **/4marks**

b. What is meant by gravitational potential? **/2marks**

c. Show that its value at the earth's surface is -62.55MJ/kg? (Mass of the earth is 6×10^{24}kg) **/2marks**

d. Find an expression for the radius of a communication satellite (gestational) in its orbit. **/3marks**

e. On the same graph,

i) Show the variation of the acceleration due to gravity inside and outside the earth's surface. **/ 2marks**

ii) Show the variation of the gravitational potential energy, kinetic energy and mechanical energy of a satellite as it moves from the surface of the earth to a higher altitude **/2marks**

20. a) Differentiate between Rutherford's atomic model and Bohr's atomic model. **/4marks**

b) (i) State Bohr's postulates of hydrogen atom. **/4marks**

ii) Propose any three deficiencies of the Bohr model of a hydrogen atom. **/3marks**

c) The frequency associated with an energy change of a hydrogen atom is 6.166×10^{14} Hz and the final energy level is 4. Determine the initial energy level. **/4marks**